10/561638
IAP9 Rec'd PCT/PTO 20 DEC 2005
PCT/EP2004/006275

"AN AIR-BAG"

THE PRESENT INVENTION relates to an air-bag for use in a motor vehicle, such as a motor car, and more particularly the present invention relates to a side air-bag.

A side air-bag is an air-bag which initially is stored within part of a vehicle seat, typically the back-rest of the vehicle seat, or in a side part of the vehicle adjacent a seat.

A side air-bag is of particular value in a side impact situation, and, as is known, air-bags which are to provide protection for an occupant of a vehicle during a side impact must be inflated extremely swiftly. Consequently it is desirable for such air-bags to be inflated with a minimum amount of gas.

Various types of side air-bag have been proposed previously.

Many prior proposed side air-bags are so-called "two-dimensional" air-bags. A two-dimensional air-bag is formed from two superimposed layers of fabric of identical size and shape which are secured together at their common periphery to form an air-bag which, in the uninflated state, can be laid out flat. The two superimposed layers may be stitched together with a peripheral seam or, alternatively, a one-piece weaving process may be utilised to produce an air-

bag of corresponding form, again having two superimposed layers of identical size and shape which are secured together at their periphery.

In spite of the fact that a side air-bag should be inflated with a minimum amount of gas, in order to facilitate rapid inflation, it is desirable that a side air-bag should have substantial "depth" so that, on inflation, the air-bag will engage with a seat occupant as soon as possible and also to provide a maximum lateral "cushion" to provide protection for an occupant, especially in a side impact situation.

With a two-dimensional air-bag, the air-bag can be inflated until the opposed sides of the air-bag bulge outwardly away from each other, thus providing depth or thickness for the air-bag, but as the air-bag is inflated in this way, firstly a substantial amount of gas has to be injected into the air-bag, and secondly the air-bag takes on an almost cylindrical form, with the pressure of gas in the air-bag being quite high. An air-bag, when inflated in this way, may not provide the desired cushioning effect but, instead, may cause a seat occupant to "bounce" off the air-bag.

It has been proposed to provide a side air-bag which is a two-dimensional air-bag of the type discussed above, the air-bag having a transverse seam in a central region thereof, dividing the air-bag into an upper inflatable region or chamber and a lower inflatable region or chamber. The two inflatable regions or chambers each have a thickness or depth, but the air-bag, in the region of the seam, has a much lower thickness or depth. The presence of the central seam does help minimise the amount of gas that is need to fully inflate the air-bag, and the presence of the seam may make it possible, as appropriate, to inflate the two chambers to different internal pressures. However, the presence of the seam in the two-dimensional air-bag means that overall

thickness of the inflatable regions or chambers of the air-bag, when it is inflated, is not very great.

It is an object of the present invention to provide an improved side air-bag for a motor vehicle.

According to the present invention, there is provided a side air-bag for a motor vehicle, the side air-bag being a three-dimensional air-bag formed from two superimposed layers of fabric which, when laid flat, have at least a substantial common area of superimposition, there being infill pieces formed from either at least one gusset forming insert or from a portion or portions of the fabric of one or both of the fabric layers which extend beyond the said common area of superimposition, the air-bag having an inflatable region towards the upper part of the air-bag and an inflatable region towards the lower part of the air-bag, the inflatable regions being separated by a part of the air-bag which is constrained, when the air-bag is inflated, to have a thickness less than the thickness of either of the said regions.

Preferably, the air-bag includes an upper chamber forming said upper region and a lower chamber forming said lower region, the upper chamber and the lower chamber being separated by a transversely extending seam.

Advantageously, the air-bag is formed from two layers of fabric of substantially identical configuration interconnected by means of a peripheral seam, there being at least one insert in said peripheral seam between the layers of fabric to form a gusset.

Conveniently, there are two inserts, one insert forming a gusset associated with one chamber and the other insert forming a gusset associated with a second chamber.

Preferably, an insert is provided with at least one vent aperture.

Advantageously, the or each vent aperture is initially sealed by means of a tear-seam.

Conveniently, the superimposed layers of fabric have a substantial common area of superimposition, each layer of fabric having one or more portions thereof which project beyond the area of superimposition, the peripheries of the areas being interconnected by means of a seam.

Preferably, a gas generator is present within the air-bag, the combination of the seam and the gas generator substantially sealing the two chambers from each other, the gas generator being configured to inflate the two chambers to different pressures.

Advantageously, the superimposed layers of fabric each have two portions which project beyond the area of common overlap, the resultant air-bag having, when inflated, an upper chamber and a lower chamber, there being a narrow inflated neck between the upper chamber and the lower chamber.

Conveniently, the two layers of fabric form part of a single fabric element.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a perspective view of an air-bag in accordance with the invention,

FIGURE 2 is a view of two fabric elements used in the manufacture of the air-bag of Figure 1,

FIGURE 3 is a side view of the air-bag of Figure 1 when inflated,

FIGURE 4 is a view of fabric elements used in the manufacture of an alternative form of air-bag,

FIGURE 5 is a view of an alternative component for use in forming an air-bag,

FIGURE 6 is a sectional view taken on the line VI-VI of Figure 5,

FIGURE 7 is a top view of a folded single fabric element in an initial stage in the assembly of an air-bag,

FIGURE 8 is an underneath view of the fabric element of Figure 7,

FIGURE 9 is a view of a further fabric element for forming an air-bag, and

FIGURE 10 is a diagrammatic view illustrating an air-bag formed from the fabric element of Figure 9 when inflated.

Referring initially to Figures 1 to 3 of the accompanying drawings, a side air-bag having an upper inflatable region or chamber and a lower inflatable region or chamber will be described.

Referring initially to Figure 1, a side air-bag 1 is formed from two superimposed identical layers of fabric 2, 3 (only the layer 2 being visible in Figure 1). The layers of fabric 2,3 are co-aligned so that the common area of superimposition is the total area of each layer, with no portion of either layer extending beyond the common area of superimposition.

As will be described, the two layers of fabric 2,3 are secured together around their periphery to form an inflatable part to the air-bag, and the inflatable part is itself divided into two inflatable regions, namely an upper chamber 4 and a lower chamber 5 by means of a transversely extending seam 6. The seam 6 extends from about the middle (in a vertical sense) of part of the air-bag 1 which will be the forward-most part of the air-bag 1 when inflated, towards a mid part of a region which will be the rear part of the air-bag when the air-bag is inflated. The seam 6 is upwardly inclined. At the rear part 7 of the air-bag a flap 8 is provided having two apertures 9, 10 formed therethrough.

A generally cylindrical gas generator 11 is provided which is to be inserted into the air-bag through an aperture formed in the region of the flap 8. The gas generator 11 is provided with two radially projecting studs 12, 13 which are positioned and dimensioned to be received through the apertures 9, 10 formed in the flap 8. When the apertures 9, 10 formed in the flap 8 are

engaged with the studs 12, 13 the air-bag 1 may be sealed. The gas generator 11 is provided with a plurality of gas outlet apertures 14. A cylindrical gas deflector 15 (shown in phantom in Figure 1) is preferably provided which surrounds the gas generator 11, the gas deflector 15 defining gas outlets 16, 17.

The combination of the gas generator 11 and the gas deflector 15 is to be inserted into the air-bag 1 through the opening provided in the region of the flap 8, and the apertures 9, 10 in the flap 8 may be engaged with the radially projecting studs 12, 13 so as to seal the air-bag. The inner-most end of the seam 6 may engage the gas deflector 16, thus separating the upper chamber 4 from the lower chamber 5 . Gas from the gas generator 11 may be injected into the upper chamber 4 through the gas outlet 16 into the lower chamber 5 through the gas outlet 17.

Figure 2 illustrates the sheet of fabric 2 used to form the air-bag of Figure 1, showing the position of the seam 6 and also showing the position of a peripheral seam 19 which serves to join the fabric layer 2 to the other identical fabric layer 3. Figure 2 also shows a separate fabric insert or infill element 20 of generally oval form, the insert 20 having opposed pointed ends.

It is to be understood that when the fabric layers 2, 3 are joined together by the peripheral seam 19, the insert 20 is introduced into the peripheral seam 19 in the lower-most part of the air-bag, that is to say in the region extending from the point A, at the end of the transversely extending seam 6, and the point B adjacent the base of the flap 8. The insert 20 has one side edge connected to the first fabric layer 2, and the other side edge connected to the other fabric layer 3, thus forming a gusset.

It is to be appreciated, therefore, that when the air-bag as shown in Figures 1 and 2 is inflated, the fabric layers 2, 3 will bow outwardly due to the pressure of gas within the chambers 4, 5, but because of the presence of the gusset formed by the insert 20, the lower chamber 5, as shown in phantom in Figure 3, may have a substantial transverse dimension or depth whereas the upper chamber 4, again as shown in phantom in Figure 3, will have a lesser dimension or depth. The lower chamber 5, which incorporates the gusset, can therefore be inflated to have a desirable substantial thickness or depth. The presence of the transverse seam 6 serves to minimise the volume of gas required to fully inflate the air-bag, and, in the arrangement shown, the gas generator may be designed so the upper chamber 4 may be inflated to a different pressure than the lower chamber 5 on actuation of the gas generator.

Figure 4 illustrates a modified embodiment of the invention. In this embodiment, instead of having two separate fabric elements 2, 3, a single fabric element 30 is provided adapted to be folded along a fold-line 31 so that a first part 32 of the fabric element overlies a second, but substantially mirror image part 33. Thus, when superimposed, the common area of superimposition is the total area of each part 32,33, with no portion of either part extending beyond the area of superimposition. The first part 32 has a configuration corresponding generally to that of the fabric element 2 described above with reference to Figure 2, including an upper area 34 that is to form the side-wall of an upper inflatable chamber of a side air-bag and a lower area 35 that is to form the side-wall of a lower inflatable chamber of the side air-bag, the areas 34,35 being separated by a region which is to accommodate a transversely extending seam 36 corresponding to the seam 6 of the air-bag 1 described above. The second part 33 of the fabric element has similar features and, in a central area 37, where the two parts 32 and 33 are conjoined, there are two apertures 38, 39 formed through the fabric element to receive mounting studs mounted on a gas

generator. A slit 40 through which the gas generator may be inserted into the air-bag is also formed through the central area 37 of the fabric element. Again there is a peripheral region 41 where a seam is to be provided.

In this embodiment of the invention there are two infill elements or inserts 42, 43. The first insert 42 is of oval form with pointed ends and corresponds with the insert 20 of the embodiment described with reference to Figures 1 to 3. This insert 42 is intended to be inserted between the areas 35 that are to form the side-walls of the lower inflatable chamber when the air-bag is assembled, extending from the point A adjacent the end of the seam 36 to a point B at the base of the central region 37 where the two separate parts 32, 33 of the fabric element 30 are conjoined. One side of the insert 42 is connected to a first part 32 of the fabric element 30, and the other side is connected to the other part 33 of the fabric element 30, again to form a gusset.

The second insert 43 is of somewhat larger size, but again is of generally oval form having pointed ends, this insert being configured to be inserted between the areas 34 that are to form the side-walls of the upper chamber, extending from the point C adjacent the end of the seam 36 to a point D at the upper-most part of the region 37 in which the two parts 32, 33 of the fabric element are conjoined. Thus the insert 43 forms a second gusset. The insert 43 is provided with a plurality of vent holes 44.

It is to be appreciated, therefore, that in the embodiment of Figure 4 not only is the lower inflatable chamber provided with a gusset constituted by the infill element 42 but also the upper inflatable chamber is provided with a gusset constituted by the infill element 43.

The gussets would initially be tucked into the interior of the air-bag, thus being trapped between the two parts 32, 33 of the fabric element 30. Thus the vent holes 44 would initially be closed, and no gas would be able to pass out through the vent holes 44. The vent holes would, however, become exposed on inflation of the air-bag and gas would then be able to escape through the vent holes.

In the embodiment of Figure 4, both the lower chamber and the upper chamber may have substantial thickness or depth whilst requiring a minimum quantity of gas for the inflation of the air-bag. In the region of the seam 36 the air-bag has a lesser thickness or depth.

Turning now to Figure 5, a modified insert 45 is shown intended to replace the insert 43 as described above. The insert 45 is provided with a plurality of vent holes 46, but the region of the insert provided with the vent holes 46 has been pinched and closed by means of a tear-seam 47. The tear-seam 47 thus serves initially to seal the vent holes 46. On inflation of the air-bag, when the pressure of gas within the air-bag reaches a predetermined pressure sufficient to break the tear-seam, the tear-seam breaks and gas may then escape through the vent holes 46.

Whilst the embodiments described above have all included at least one insert or infill to form a gusset in a three-dimensional air-bag, a three dimensional air-bag may alternatively be formed using two layers of fabric which are superimposed to define a common area of superimposition, wherein at least one of the layers of fabric has a region which extends beyond the common area, the periphery of the first layer of fabric being secured to the periphery of the second layer of fabric, thus forming an air-bag with three-dimensional properties. Preferably the length of the periphery of one of the

layers of fabric is identical to the length of the periphery of the other layer of fabric.

Figures 7 and 8 show, from opposite sides, a single fabric element 50 having two parts 51, 52 which have been folded about a fold-line 53 so as to be superimposed as an intermediate step in the fabrication of an air-bag.. The part 51 is shown to be on the top in Figure 7 and the part 52 is shown to be on the top in Figure 8. It can be seen that there is a very substantial area of common overlap in which the part 51 partially overlies the part 52, but there are protruding portions 54, 55, 56, 57 of the part 51 which protrude beyond the area of common overlap, and also it can be seen that there are protruding portions 58, 59, 60, 61 of the part 52 which extend beyond the area of common overlap.

It is to be appreciated that adjacent the fold-line 53, a region is provided having mounting apertures 62, 63 in the part 51, there being a slit or opening in the region of the fold-line 53 to enable a gas generator of the type shown in Figure 1 to be introduced into the air-bag, with the studs on the gas generator being engaged with the apertures 62, 63 to hold the gas generator in position and to seal the air-bag.

It is to be understood that an internal transversely extending seam 66 is provided which interconnects the two parts 51, 52 of the fabric element 50 so the seam extends across the area of common overlap and terminates adjacent the said apertures 62, 63. Here it is to be understood that when the gas generator is mounted in position within the air-bag, a gas deflector provided on the gas-generator may contact the seam 66 thus separating the air-bag into two separate inflatable regions or chambers, the chambers being separated by the seam 66.

It is to be appreciated that as the air-bag is assembled from an intermediate position shown in Figures 7 and 8, the peripheries of the two superimposed parts 51, 52 are brought into alignment with an appropriate manipulation of the fabric of the air-bag, and the aligned peripheries are interconnected by stitching, for example, thus forming an air-bag in which there is a lower inflatable region or chamber which is a three-dimensional chamber, defined by the superimposed fabric layers in the region 67 and a corresponding upper inflatable region or chamber in the region 68. The protruding portions 54-61 all form infill elements, equivalent to the inserts of the embodiments described above. The inflatable regions or chambers 67, 68 may have a significant thickness or depth, when the air-bag is inflated, but the air-bag will have a minimum thickness or depth in the region of the seam 66.

Figure 9 illustrates another embodiment of the invention in which a single fabric element is used to form a three-dimensional air-bag. In this embodiment, however, there is no transverse seam dividing the air-bag into separate chambers.

Referring to Figure 9, a single element of fabric 70 is shown having two substantially mirror-image parts 71, 72 interconnected by a connecting region 73. Within the connecting region 73 there are two apertures 74, 75 to engage studs provided on a gas generator and an access slit 76 to enable a gas generator to be inserted into the air-bag to be fabricated.

It is to be understood that during the fabrication process the fabric element 70 will be folded about a fold-line 77 which passes through the interconnecting region 73, so that the part 71 is partially superimposed over the part 72 as shown in phantom in Figure 9. Here it is to be appreciated that when

in the folded condition there is a substantial common area of overlap, the part 72 will have regions 78 and 79 which extend beyond the area of common overlap, and the part 71 will have portions 80, 81 which extend beyond the area of common overlap. Again the fabric layers are interconnected by means of a peripheral seam 82, with the fabric being manipulated so that the peripheries of the areas are brought together.

An air-bag, fabricated from a fabric element as shown in Figure 9 will, when inflated, tend to have an upper inflatable region 83 of relatively large thickness and depth, and a lower inflatable region 84 also of relatively large thickness and depth, interconnected by a neck region 85 of much less width or depth. Again the air-bag may be inflated using a minimum quantity of gas, but is provided with inflatable regions which have a substantial thickness or depth, thus enabling the air-bag to be brought into physical contact with a seat occupant relatively swiftly on deployment of the air-bag, and also enabling the air-bag to provide an adequate protective or cushioning effect.

In the present Specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".